Weekly Work Report

Wenjie Niu

VISION@OUC

July 7, 2018

This week, I start the Deep Learning course. Although I watched the course and took some notes before, the real and deep understanding is not enough for me. Therefore, it's necesaary to learn again. In this week, I'm learning the introduction of deep learning, the main content is here as following.

1 Content

1.1 Courses in This Specialization

- Neural Networks and Deep Learning
- Improving Deep Neural Networks: Hyperparemeter tuning, Regularization and Optimization.
- Structure your Machine Learning project
- Convolutional Neural Networks
- Natural Language Processing: Building sequence models

1.2 Neural Network

It's a powerful learning algorith inspired by how the brain works. Here are 2 examples to show what is a Neural Networks.

- Example 1: Single Neural Networks [1].

  Given data about the size of houses in real estate market, and you need to fit a function that will predict their price.The curve of the price is similar to Rectified Linear Unit(ReLU) fuction in Fig. 1. While the difference is that the real curve can never be negative and it starts at zero.

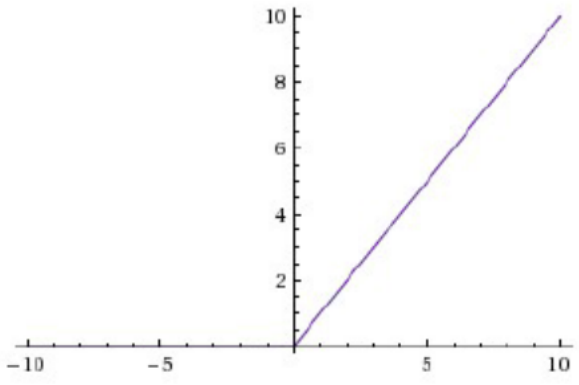

Figure 1: Rectified Linear Unit(ReLU) fuction

- Example 2: Multiple Neural Networks [1].

  The price of houses can be affected by other features such as size, numbers of bedrooms, zip code and wealth. The role of the neural network is to predict the price and it will automatically generate the hidden units. We only need to give the input x and the output y as shown in Fig. 2.

1.3 Supervised Learning for Neural Network

In supervised learning, we are given a data set and already know what our correct output should look like, having the idea that there is a relationship between the input and the output as shown in Table 1.

Supervised learning is categorized into "regression" and "classification" problems. In a regression problem, we are trying to map input variables to some continuous function, predicting the results within

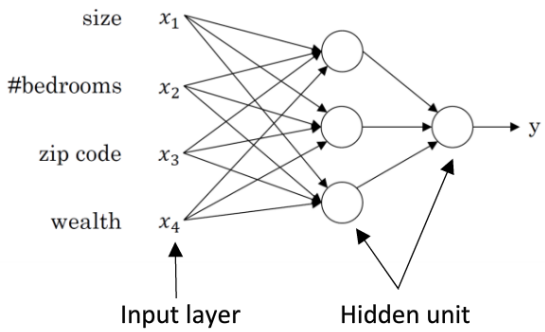

Figure 2: Multiple Neural Network [2]

Size	#bedrooms	···	Price (1000$s)
2104	3		400
1600	3		330
2400	3		369
⋮	⋮		⋮
3000	4		540

User Age	Ad Id	···	Click
41	93242		1
80	93287		0
18	87312		1
⋮	⋮		⋮
27	71244		1

Figure 3: Structured data [2]

Figure 4: Unstructured data [2]

the a continuous output. In a classification problem, we are trying to map input variables into discrete categories.

Table 1: Here are some examples of supervised learning

Input(x)	Output(y)	Application
Home features	Price	Real estate
Ad, user info	Click on ad?(0/1)	Online advertising
Image	Object	Photo tagging
Audio	Text transcript	Speech recognition
English	Chinese	Language translation
Image, Radar info	Other cars position	Autonomous driving

There are different types of neural network, for example Convolution Neural Network(CNN) used often for image application and Recurrent Neural Network used for one-dimensional sequence data.

Another significant concept is about structured in Fig. 3 and unstructured data in Fig. 4. Structured data refer to things that has a defined meaning such as price, age while unstructured data refers to thing like pixel, raw audio, text.

1.4 Why Is Deep Learning Taking off?

Deep learning is taking off due to a large amount of *data* avilable through the digitization of society, faster *computition* and innovation in the development of neural network *algorithm*.

When there are a small training set, the performance depends much on skill at hand engineer features.

But it doesn't work when a huge training set. Two things have to be considered to get the high level of performance:

- Being able to training enough neural network
- Huge amount of labeld data

In a word, scale drives deep learning progress.

1.5 Some Important in Test 1

After the part of courses, there are still some concept not being understood. In this subsectio, I will list to enhance them.

- Structured and Unstructured data.

  Structured: Things have a defined meaning like economic *etc.* While Image of cat is unstructured data.

- Increasing the size of a neural network generally does not hurt an algorithm's performance, and it may help significantly; Increasing the traing set size generally does not hurt an algorithm's performance, and it may help significantly.

1.6 Binary Classification

In a binary classificartion problem, the result is a discrete value output.
For example: Cat vs. Non-Cat
The goal is to train a classifier that the input is an image represented by a feature vector x, and predicts whether the corresponding label is 1 or 0. In this case, whether this is a cat image(1) or a non-cat image(0).

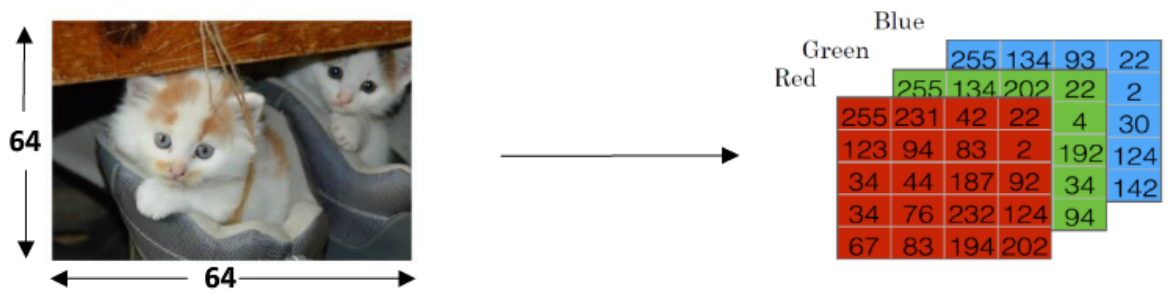

Figure 5: Here is the figure of cat-to-matrics [1][2].

An image is store in the computer in three seperate matrics corresponding to the Red, Green, and Blue color channels of the image. The three matrics have the same size as the image, for example, the resolution of the cat is 64 pixels × 64 pixels, the three matrics(RGB) are 64 × 64 each as figure. 5.

The value in a cell represents the pixel intensity which will be used to create a feature vector of n-dimension. In pattern recognition and machine learning,a feature vector represents an object, in this case, a cat or no cat.

To create a feature vector x, the pixel intensity values will be "unroll" or "reshape" for each other color. The dimension of the input feature vector x is n_x=64 × 64 × 3 = 12288.

$$x = \begin{bmatrix} 255 \\ 231 \\ 42 \\ \vdots \\ 255 \\ 134 \\ 202 \\ \vdots \\ 255 \\ 134 \\ 93 \\ \vdots \end{bmatrix}$$

Notation
The last matric in Eq. 1

$$(x, y) \qquad x \in R^{n_x}, y \in \{0, 1\} \tag{1}$$

m training example in Eq. 2

$$\{(x^{(1)}, y^{(1)}), (x^{(2)}, y^{(2)}), \cdots, (x^{(m)}, y^{(m)})\} \tag{2}$$

1.7 Logistic Regression

Logistic regression is a learning algorithm used in a supervised learning problem when the output y are all either zero or one. The goal of a logistic regression is to minimize the error between its predictions and training data.

Like the example in last subsection, given an image represented by a feature vector x, the algorithm will evaluate the probability of a cat being in that image like 3

$$Given \quad x, \quad \hat{y} = P(y = 1|x), \quad where \quad 0 \leq \hat{y} \leq 1 \tag{3}$$

The parameters used in Logistic Regression are:

- The input features vector: $x \in R^{n_x}$, where n_x is the number of features
- The traing label: $y \in \{0, 1\}$
- The weights: $\omega \in R^{n_x}$, where n_x is the number of features
- The threshold: $b \in R$
- The output: $\hat{y} = \sigma(\omega^T + b)$
- Sigmoid function: $s = \sigma(\omega^T + b) = \sigma(z) = \frac{1}{1+e^{-z}}$

$(\omega^T + b)$ is a linear function $(ax + b)$, but since we are looking for a probability constraint between [0.1], the sigmoid function as shown in figure. 6 is used.

Some observation from the graph:

- If z is a large positive number, then $\sigma(z) = 1$
- If z is small or large negative number, then $\sigma(z) = 0$
- If $z = 0$, then $\sigma(z) = 0.5$

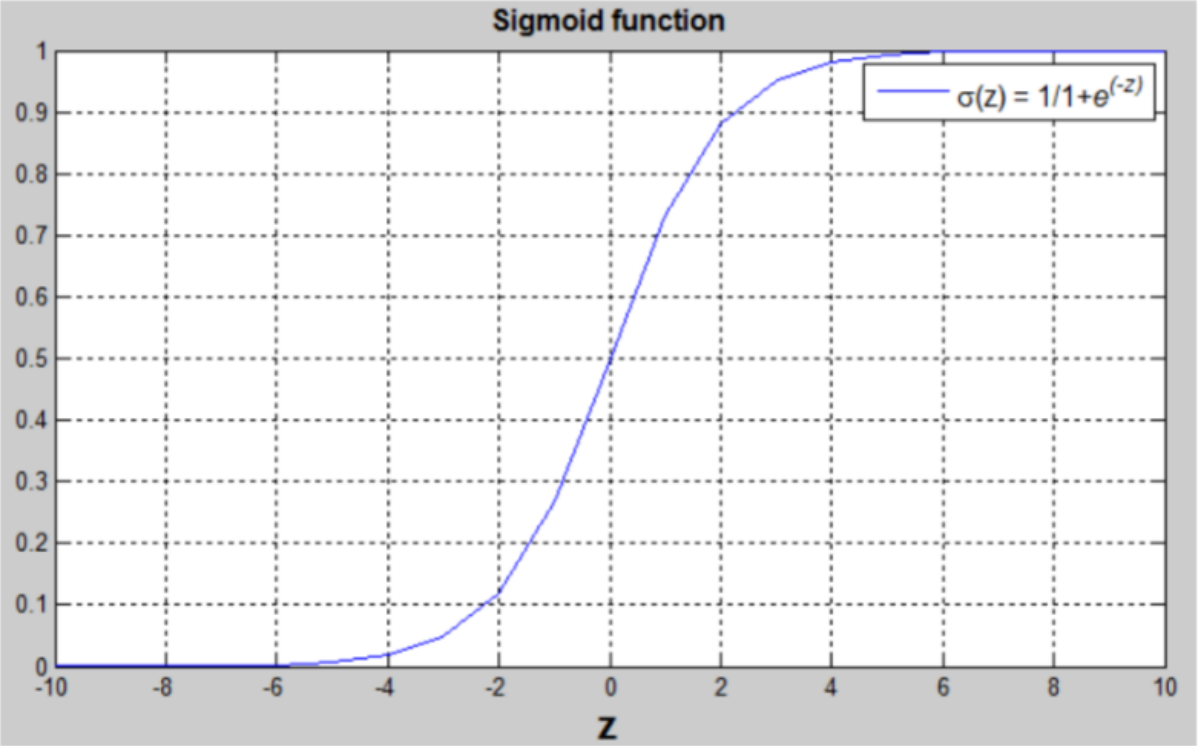

Figure 6: Sigmoid function

2 Progress in this week

This week I learnt the introduction of deep learning including some new concepts such as neural network, supervised learning, and the reason of deep learning's prosperity. The following are the steps you took:

Step 1 Watched the courses clips.

Step 2 Wathced again and took notes.

Step 3 Grasped the related pictures and wrote the Latex.

Step 4 Organized the content and push to the github.

3 Plan

Objective: Learn Neural Network and Deep Learning by myself.

2018.07.08—2018.05.14 Watch the rest of week two course clips and take the note.

2018.07.15—2018.07.21 Do so on week three course.

2018.05.22—2018.05.38 Do so on week tfour course.

References

[1] A. Ng. Neural network and deep learning. `http://mooc.study.163.com/smartSpec/detail/1001319001.htm`.

[2] A. Ng. Neural network and deep learning. `https://www.coursera.org/learn/neural-networks-deep-learning/exam/QR8kq/introduction-to-deep-learning`.